

Simulated In-Use Tests to Evaluate a Non-Adherent Antimicrobial Silver Alginate Wound Dressing

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Abstract

Aims

To evaluate by *in-vitro* methods a novel Non-Adherent Antimicrobial Silver Alginate Wound Dressing, that has been developed for use on moderately to highly exuding chronic wounds.

Methods

A new *in vitro* method has been established that measures the ability of a dressing material to adhere to a simulated biological matrix, a fibrin clot. The grams force (gf) required to separate the dressing from a clot indicates the potential for dressing adherence *in vivo*.

Additionally, a variety of performance characteristics have been assessed using *in vitro* simulated in-use tests, namely, absorbency, wet tensile strength, silver availability and antimicrobial activity. Total absorbent capacity was measured using the BP 1993, Addendum (1995) Alginate Dressing, Absorbency assay. The availability of silver ions for antimicrobial activity was demonstrated by measuring the silver released from the wound dressing into simulated wound fluid, changed each day, re-challenging the wound dressing over 7 days. Microbiological activity was demonstrated using zone of inhibition and Log₁₀ reduction assays against common chronic wound pathogens.

Results

The Non-Adherent Antimicrobial Silver Alginate Dressing measured <160gf using the fibrin clot method, compared to other alginate/fibrous based wound dressings measuring in the range of 384-910gf. The combination of alginate with a Non-Adherent layer significantly decreases any potential adherence of alginate to an *in-vitro* biological matrix, used to represent the wound bed.

The Non-Adherent Antimicrobial Silver Alginate Dressing maintained all other desired characteristics including its high absorbency and wet tensile strength. The dressing was shown to release silver over the 7 day re-challenge test period. The dressing was efficacious against a broad-spectrum of micro-organisms.

Conclusion

These in-use tests demonstrated the suitability of this Non-Adherent Antimicrobial Silver Alginate Dressing in the management of moderately to heavily exuding wounds. Additionally, this dressing provides the unique benefit of a non-adherent wound contact layer.

Antimicrobial dressing is SILVERCEL® SILVERCEL is a registered trademark of Systagenix Wound Management.

Non-Adherent Antimicrobial Wound Dressing is Maxisor® Extra Ag. Maxisor is a registered trademark of Systagenix Wound Management.

Absorbent Antimicrobial Dressing is Actisor® Absorbent. Actisor is a trademark of Systagenix Wound Management.

HydroFiber® Dressing with Ionic Silver is Applied Ag. Applied Ag and Applied are trademarks of Colson Inc. USA.

Calcium Alginate Dressing with Antimicrobial Silver is Algisor® Algisor is a trademark of Colson Science Inc.

Aims

Evaluate the properties, *in vitro*, of a Novel, Non-Adherent Antimicrobial Silver Alginate dressing.

Measure the relative potential adherence of a number of wound dressings.

Methods

• **Absorbency**, absorbent capacity, BP 1993, Addendum (1995) For Alginate Dressings

Wet test dressing, add a weight equal to 40 times the dressing weight of calcium chloride / sodium chloride solution. Incubate at 37°C for 30 minutes. Remove dressing and allow to drain for 10 seconds, reweigh test dressing.

• **Silver release**

Immerse dressing in simulated wound fluid (SWF). Sample fluid and transfer test dressing to fresh SWF daily. Analyse silver levels by Atomic Absorption (AA) Spectroscopy.

• **Wet Tensile Strength**

Cut sample from the width and the length of the dressing. Immerse in calcium chloride / sodium chloride solution for 15 minutes. Remove sample and allow to drain. Place in the Instron tensile tester and pull apart to measure the force required to break the dressing.

• **Antimicrobial activity**

Zone of inhibition test, Pre-wet dressing in simulated wound fluid. Place dressing on bacterial lawn. Incubate for 24 hours at 37°C. Measure zone of inhibition.

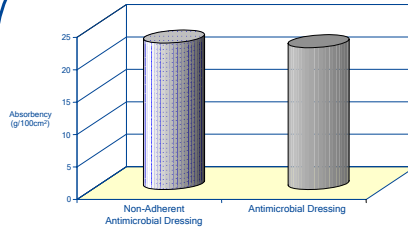
Log₁₀ reduction test, Place dressing in a quantified bacterial suspension. Sample bacterial suspension at frequent time points over the duration of the test, 3 hours. Reduction of viable bacterial number calculated.

• ***In vitro* adherence model**

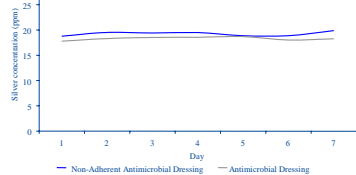
Sandwich a fibrin clot between two pieces of dressing material. Incubate for 24 hours at 37°C. Measure the force required to separate the dressing from the clot using the Instron tensile tester.

Results

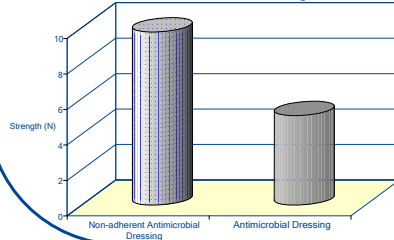
Absorbent capacity



Silver release



Wet tensile strength

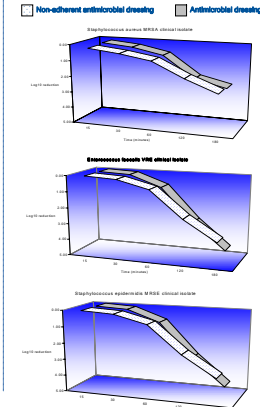


Antimicrobial activity

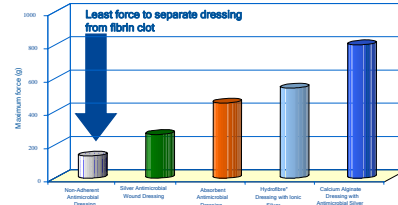
Zone of inhibition
Effective against a broad spectrum of microorganisms including *Clostridium difficile*

- | | |
|----------------------------|-------------------------------|
| <i>Acinetobacter</i> sp. | <i>Klebsiella</i> sp. |
| <i>Aeromonas</i> sp. | <i>Micrococcus</i> sp. |
| <i>Aspergillus</i> sp. | <i>Morganella</i> sp. |
| <i>Bacteroides</i> sp. | <i>Peptostreptococcus</i> sp. |
| <i>Bacillus</i> sp. | <i>Porphyromonas</i> sp. |
| <i>Branhamella</i> sp. | <i>Prevotella</i> sp. |
| <i>Burkholderia</i> sp. | <i>Propionibacterium</i> sp. |
| <i>Candida</i> sp. | <i>Proteus</i> sp. |
| <i>Citrobacter</i> sp. | <i>Providencia</i> sp. |
| <i>Clostridium</i> sp. | <i>Pseudomonas</i> sp. |
| <i>Comamonas</i> sp. | <i>Salmonella</i> sp. |
| <i>Corynebacterium</i> sp. | <i>Serratia</i> sp. |
| <i>Enterobacter</i> sp. | <i>Staphylococcus</i> sp. |
| <i>Enterococcus</i> sp. | <i>Streptophomonas</i> sp. |
| <i>Escherichia</i> sp. | <i>Streptococcus</i> sp. |
| <i>Eubacterium</i> sp. | <i>Veillonella</i> sp. |

Effective against antibiotic resistant organisms



Potential adherence



The data presented is the average force required to separate the dressing material from a fibrin clot.

For each dressing tested, shown from left to right on the graph, the average result was 132g, 263g, 452g, 542g and 802g, respectively.

Conclusion

The dressing properties evaluated, *in vitro*, demonstrate the suitability of a Non-Adherent antimicrobial silver alginate dressing for use on moderately to heavily exuding chronic wounds.

The Non-Adherent antimicrobial silver alginate dressing is a dressing with the unique benefit of a perforated film on both sides of an existing dressing material (the antimicrobial dressing) composed of alginate/CMC and silver fibres.

The data presented herein¹ shows that the addition of a perforated film does not compromise the existing dressing attributes of the antimicrobial dressing, a product currently used in clinical practice for the treatment of partial and full thickness chronic wounds^{2,3,4,5}.

The Non-Adherent antimicrobial silver alginate dressing has increased tensile strength compared to the antimicrobial dressing.

Significantly, less force is required, *in vitro*, to separate the Non-Adherent antimicrobial silver alginate material from a fibrin clot than that required for other commercially available wound dressings.

Clinically, reducing any potential adherence of wound dressings to the wound surface should be of benefit, both to the patient and clinician.

1. Data on file, Systagenix Wound Management
2. Systematic review of CDSS implementation of using a silver hydrogel dressing in Acute, Subacute and Chronic Wound Management. WOUNDS UK, 2008; 20(12): 120-124.
3. Cochrane Review: The use of Silver in the acute and chronic management of burn injury. WOUNDS UK, 2008; 20(12): 124-126.
4. Reynolds J, Clark R, Clark S. Evaluation of a novel antimicrobial hydrogel dressing in chronic wounds with signs of local infection. Journal of Wound Care, 2005; 15(5): 41-45.
5. Clark R et al. The management of chronic leg ulcers. WOUNDS UK, 1998; 10(1): 1-6.